

2. (Six Times Amended) A semiconductor comprising:

- a semiconductor substrate material having a surface;
- a barrier film in direct contact with said semiconductor substrate surface, said barrier film having a layer comprising elemental barium atoms on said surface;
- a conductor directly on said barrier film, said conductor having a tendency to diffuse into said semiconductor substrate material if in direct contact therewith; and

wherein said elemental barium atoms are between said conductor and said semiconductor substrate such that said layer serves as a barrier, inhibiting diffusion of the conductor into the semiconductor substrate material.

21. (Twice amended) A semiconductor device according to claim 1, wherein said barrier film comprises a plurality of contiguous monolayers of barium atoms located on a surface of said substrate material.

23. (Five Times Amended) A semiconductor device comprising:

- a semiconductor substrate;
- a barrier film comprising elemental barium atoms, having a thickness in the range of approximately 5 Å to approximately 100 Å in direct contact with said substrate; and
- a metallic material directly on said barrier film such that said elemental barium atoms are between said metallic material and said semiconductor substrate.

A copy of these claims, with amendments marked, is appended to the present Response.

REMARKS

Claims 1-13, 21 and 23-28 are currently pending in the present application. Claims 1, 2, 21 and 23 are amended herein. The withdrawal of the Examiner's previous indication that claims 1, 21 and 27 are allowable is acknowledged.

Informality

Claim 21 is amended herein to replace "said surface" in line 3 of claim 21, with "a surface" as suggested by the Examiner.

Rejection under 35 U.S.C. § 102

Claims 1, 21, and 27 stand rejected as allegedly anticipated by unexamined Japanese Patent No. 6-164004, issued to Suzuki (hereinafter "Suzuki"). Applicants respectfully traverse this rejection for the reasons set forth below.

It is well established that "[a] claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." M.P.E.P. § 2131, *citation omitted*. Applicant respectfully submits that Suzuki does not identically set forth the invention as claimed in newly amended claim 1.

Claim 1, as amended herein, specifically recites that the metallic material directly on the barrier film. A basis for this amendment may be found, for example, in the specification on page 21 at lines 1 to 14, and on page 33 at line 14 to page 34 at line 14, *inter alia*.

In Suzuki, by contrast, several layers of other materials are interposed between the barium monolayer and the metallic layer. *See* Suzuki Figure 5(d) and paragraphs 25 to 28. Specifically, the Examiner takes the position that layer 5 of Suzuki corresponds to the substrate, as claimed, that layer 6 of Suzuki corresponds to the barrier film, as claimed, and that layer 9 of Suzuki corresponds to the metallic material, as claimed. However, in Fig. 5(d) of Suzuki, two additional layers 7 and 8 are interposed between the layer 6 and the layer 9, relied on by the Examiner. Therefore, Suzuki does not set forth each element of newly amended claim 1 since the layer 9 of Suzuki is not located directly on the layer 6 as is now required by amended claim 1. Accordingly, Applicants respectfully submit that newly amended claim 1 is not anticipated by Suzuki.

Moreover, amended claim 1 is not obvious over Suzuki since Suzuki teaches that the additional two layers 7, 8 are required and there is no teaching or suggestion in Suzuki that these layers 7, 8 can be omitted to thereby place the layer 9 directly on the layer 6, as would be required to arrive at the present invention.

Claims 21 and 27 depend from claim 1. Applicants respectfully submit that, because newly amended claim 1 is not anticipated by Suzuki, it follows by statute that claims 21 and 27 are also not anticipated. Therefore, Applicants respectfully request that the rejection under 35 U.S.C. § 102 be withdrawn upon reconsideration.

Rejections under 35 U.S.C. § 103

Claims 2, 6 to 13, and 28 have been rejected as allegedly obvious over Suzuki. Claims 3, 4, 5, and 23 to 26 have also been rejected as allegedly obvious over Suzuki in view of U.S. Patent No. 5,877,086, issued to Aruga (hereinafter "Aruga"). Applicants respectfully traverse these rejections for the reasons set forth below.

It is well established that

[t]o establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, **the prior art reference (or references when combined) must teach or suggest all the claim limitations.** The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure.

M.P.E.P. § 2143, *emphasis supplied, citations omitted*. Applicants respectfully submit that the Official Action does not set forth a *prima facie* case of the obviousness of independent claims 2 and 23, as amended, over Suzuki, because Suzuki does not teach or suggest every element of Applicants' claimed invention.

Claims 2 and 23 are amended herein to specifically recite that the conductor or the metallic material are directly on the barrier film. A basis for this amendment may be found, for example, in the specification on page 21 at lines 1 to 14, and on page 33 at line 14 to page 34 at line 14, *inter alia*.

In Suzuki, as set forth in detail above, several layers of other materials are interposed between the barium monolayer and the metallic layer. See Suzuki Figure 5(d) and paragraphs 25 to 28. Specifically, the Examiner takes the position that layer 5 of

Suzuki corresponds to the substrate, as claimed, that layer 6 of Suzuki corresponds to the barrier film, as claimed, and that layer 9 of Suzuki corresponds to the conductor or metallic layer, as claimed. However, in Fig. 5(d) of Suzuki, two additional layers 7 and 8 are interposed between the layer 6 and the layer 9, relied on by the Examiner. Therefore, Suzuki does not set forth each element of newly amended claims 2 and 23 since the layer 9 of Suzuki is not located directly on the layer 6 as is now required by amended claim 1. Therefore, Suzuki does not teach or suggest each element of newly amended claims 2 and 23.

Moreover, amended claims 2 and 23 are not obvious over Suzuki since Suzuki teaches that the additional two layers 7, 8 are required and there is no teaching or suggestion in Suzuki that these layers 7, 8 can be omitted to thereby place the layer 9 directly on the layer 6, as would be required to arrive at the present invention. Accordingly, Applicants respectfully submit that newly amended claim 2 is not obvious over Suzuki.

Claims 6 to 13 and 28 depend, directly or indirectly, from claim 2. Applicants respectfully submit that, because newly amended claim 2 is not obvious over Suzuki, it follows by statute that claims 6 to 13 and 28 are also not obvious. Therefore, Applicants respectfully request that this rejection under 35 U.S.C. § 103 be withdrawn upon reconsideration.

Aruga has been cited in support of the proposition that barrier layers having a thickness of about 5 to about 100Å are known in the art. Aruga, however, describes a barrier layer of titanium or titanium nitride 110, not barium, as specifically recited in claims 2 and 23 and a layer of conductive metal 114. Furthermore, in Aruga, there is a non-conducting wetting layer 112 interposed between the barrier layer 110 and the conductive metal 114. *See, e.g.*, Aruga column 3 at lines 52 to 64. Therefore, Aruga also fails to teach or suggest that the metallic layer is directly on the barrier layer. Accordingly, Applicants respectfully submit that the Official Action has not set forth a *prima facie* case of obviousness over Suzuki in view of Aruga.

Claims 3, 4, and 5 depend from claim 2, and claims 24, 25, and 26 depend from claim 23. Applicants respectfully submit that, because newly amended claims 2 and 23 are not obvious over Suzuki in view of Aruga, it follows by statute that claims 3, 4, 5, 24,

25, and 26 are also not obvious. Therefore, Applicants respectfully request that this rejection under 35 U.S.C. § 103 be withdrawn upon reconsideration.

Double Patenting

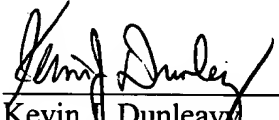
Claims 1 to 13, 21, and 23 to 28 have been rejected under the judicially-created doctrine of obviousness-type double patenting, citing U.S. Patent No. 6,456,887, issued to Chu et al. (hereinafter "Chu"). Applicants respectfully traverse this rejection, on the grounds that the newly amended claims are not, in fact, obvious over the claims of the cited reference.

As set forth in detail above, the independent claims of the present application, as amended herein, now specifically recite that the metallic layer is directly on the barrier layer. In Chu, however, a metal halide layer is interposed between the monolayer of metal atoms and the single crystal transition metal. *See* Chu, claims 1, 12, and 14. Therefore, Chu does not teach every element of the claimed invention, and the newly amended pending claims are not obvious over the invention claimed in Chu. Accordingly, Applicants respectfully request that the rejection for non-statutory double patenting be withdrawn upon reconsideration.

Conclusion

In view of the foregoing amendments and remarks, Applicants respectfully submit that all of the pending claims are in condition for allowance and respectfully request a favorable Office Action so indicating.

Respectfully submitted,


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Appendix: Claims with Markings to Show Amendments Made

CLAIMS WITH MARKINGS TO SHOW AMENDMENTS MADE

1. (Twice Amended) A semiconductor device comprising:
 - a substrate;
 - a barrier film having a monolayer of elemental barium atoms on said substrate;
 - and
 - a metallic material directly on said barrier film
2. (Six Times Amended) A semiconductor comprising:
 - a semiconductor substrate material having a surface;
 - a barrier film in direct contact with said semiconductor substrate surface, said barrier film having a layer comprising elemental barium atoms on said surface;
 - a conductor directly on said barrier film, said conductor having a tendency to diffuse into said semiconductor substrate material if in direct contact therewith; and
 - wherein said elemental barium atoms are between said conductor and said semiconductor substrate such that said layer serves as a barrier, inhibiting diffusion of the conductor into the semiconductor substrate material.
21. (Twice amended) A semiconductor device according to claim 1, wherein said barrier film comprises a plurality of contiguous monolayers of barium atoms located on ~~said a~~ surface of said substrate material.
23. (Five Times Amended) A semiconductor device comprising:
 - a semiconductor substrate;
 - a barrier film comprising elemental barium atoms, having a thickness in the range of approximately 5 Å to approximately 100 Å in direct contact with said substrate; and
 - a metallic material positioned directly on said barrier film such that said elemental barium atoms are between said metallic material and said semiconductor substrate.